

Surface Reflectance Product Workplan

Jeff Masek, Eric Vermote, David Roy, Robert Wolfe, Feng Gao

What activities and/or decisions are needed to implement an operational Landsat SR product?

1. Algorithm options
2. Algorithm refinements
3. Operational Considerations
4. Science Team Involvement

1. Existing algorithms: LEDAPS vs WELD

Both options are similar in that they use the 6S RT model

LEDAPS:

image-based aerosols using DDV; continental model (1km resolution)

Rayleigh-corrected reflectance used for cloud screening AOT targets

NCEP water vapor (2.5 deg resolution)

TOMS/EP-TOMS/OMI ozone (1 deg resolution)

NCEP surface pressure + elevation (2.5 deg/90m resolution)

Aerosols may be less accurate

Can correct TM/ETM+ archive since 1982

WELD:

MODIS-based aerosol and water vapor (10 km resolution)

LUT for RT calculations (faster)

Aerosols may be more accurate for MODIS-era

Capability to integrate multiple aerosol models (e.g. dust vs pollution)

Cannot correct pre-2000 archive

Algorithm Choice (cont'd)

- LEDAPS needs to be used for the older part of the Landsat archive
- Post-2000 archive could use WELD approach for better accuracy, but continuity also important (ie. important to introduce no bias)
- D. Roy and E. Vermote comparing both approaches this summer – expect results within three months

RECOMMENDATION:

- Begin implementation of LEDAPS code at EROS for all TM/ETM+ data
- Use Roy/Vermote analysis to decide if post-2000 acquisitions should rely on WELD rather than LEDAPS

**** Note – USGS EROS is beginning implementation of LEDAPS for FCDR & ECV development**

2. Algorithm Refinements

- Currently solar geometry is constant for the scene in both LEDAPS and WELD approaches
- Benefits to moving toward per-pixel solar geometry probably 2nd order
- Surface reflectance product offers potential for improved cloud/shadow mask

RECOMMENDATION:

- Initially use scene-based solar geometry, but perform study to quantify magnitude of difference to SR if per-pixel geometry used (by latitude, season).
- Consider activity to generate post-SR cloud/shadow mask as part of SR processing

3. Operational Considerations

- LEDAPS aerosols may be inaccurate in hyper-arid areas where DDV targets not available; however impact on SR for bright targets appears to be small
- Polar areas problematic for 6S (BRDF impact of snow cover & low sun elevation)
- Coastal regions can be problematic for LEDAPS if land area is small
- Excessive cloud contamination hurts aerosol retrieval (missed clouds + adjacency effect)

RECOMMENDATION:

- Do not correct land area north/south of +/- 65 degrees
- Consider option for Rayleigh+ absorption correction
- Additional testing of SR accuracy in desert regions (+ suggest giving users a warning about accuracy for arid regions initially).
- Only correct imagery w/ <30% cloud cover

Operational Considerations (cont'd)

- Missing ancillary data (especially ozone) a problem. Seems to get worse for OMI era (2009-10)?

RECOMMENDATION:

- Work with GSFC to gap-fill ozone record for 1982- current
- Implement branch to preclude correction in the absence of valid ozone data (or at least warn user?)
- QA process very important for success of implementation
- Post-2000 aggregated data can be compared to MODIS SR & NBAR directly
- Pre-2000 data could be compared to LTDR?
- MODIS uses visual inspection of each granule – may not be possible for on-demand Landsat SR product.

RECOMMENDATION:

- EROS needs to implement a QA process for each processed scene. At a minimum suggest comparison with MOD09 data for post-2000 acquisitions

4. Science Team involvement

- Operational atmospheric correction requires a dedicated team to monitor results and continue validation
- “Turning the crank” is too optimistic – maintaining product quality will require continued investigations into issues/problems
- USGS should build long-term relationship with scientists who can perform validation, diagnosis issues, and improve algorithms

RECOMMENDATION:

- USGS should contract with scientist(s) for long-term algorithm validation and maintenance activities; current science team support is not adequate for this role
- USGS should regularly review product accuracy & algorithm development with the Landsat Science Team

Overall Recommendations

- EROS should pursue implementing a Landsat TM/ETM+/OLI surface reflectance product (1982-). Initially focus on LEDAPS; consider merging with WELD approach for post-2000 imagery.
- Rather than allow on-demand production for the entire archive, suggest implementing pilot program for 1st year
 - Limited geographic/temporal scope (e.g. US only, 2005, 2010?)
 - Pre-compute SR products and conduct visual QA for every product
 - Integrate products with validation activities (e.g. Aeronet)
 - Assess user feedback, and QA/validation stats
 - Publish results and use as basis for wider deployment in 2011-12
- Continued science team involvement critical to success